Reinforced Composite System for Constructing Insulated Concrete Structures

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CROSS REFERENCES TO RELATED APPLICATION

This is a continuation in part of Serial No. 09/803,205, filed March 09, 2001 and titled "System for Constructing Insulated Concrete Structures."

BACKGROUND OF THE INVENTION

The present invention relates to construction using Insulating Concrete Forming Systems (ICFS), and more particularly to a new reinforced composite system for constructing insulated concrete structures.

Insulating Concrete Forming Systems (ICFS), which are currently known, act as forms for the construction of concr te walls, th nd b n fit is a wall which is already

insulated and r ady for the application of xterior and interior finish materials. The known ICFS currently in use comprise a pair of foam plastic pan ls connected by a plurality of ties or connectors. The panels are molded from expanded polystyrene (EPS) beads providing low density foam plastic panels which are used as a form to contain the concrete during placement. The EPS beads are expanded with high pressure steam, in molds that are confined by a large press.

An example of Known art U.S. Pat. No. 5,896,714 issued to Cymbala et al. on Apr. 27, 1999 comprises pairs of panels molded from EPS and connected by ties. The ties have opposed vertical flanges with web portions extending between. In one embodiment the flanges of the ties are molded within the panels, the web members extending between panels. In another embodiment the panels are formed with "T"-shaped slots amenable to accept the flanges of the ties.

Another example of known art is U.S. Pat. No. 6,170,220 issued to Moore, Jr. on Jan. 9, 2001 comprising opposing panels molded from EPS and using molded-in web members. The web members have attachment points that extend past the inside face of the panels, the connecters extend between and engage the attachment points of opposing panels.

Known art systems are limited in many respects due to the materials used, the manufacturing process and the configuration of the ties, webs and connectors. The EPS foam doesn't adhere to the ties and webs when using molded-in configurations causing a weak point in the panels at each tie or web location. In the slide-in configurations the molded slots penetrate deeply into the panels also creating a weakness at each

penetration. There are no ties or webs located at the panel ends allowing the vertical joints to bulg or blowout during concrete placement. The pan ls ar manufactured in small units approximately 12 inches to 16 inches in height and 36 inches to 48 inches in length, the size being limited by the strength of the low density EPS and the prohibitive cost of larger molds and more expensive machinery to contain the molds during the high pressure steam expansion process. EPS has a relatively low R-value per inch and the poor structural characteristic make it prone to damage during material handling and construction.

The tie configuration disclosed in Cymbala is typical of many of the known art systems, the webs of the ties comprising closely spaced members leaving little open space through the webs, in effect perforating the concrete at each tie location. In Moore, Jr. there are numerous connectors required between the panels to hold the pressure of the poured concrete. These restrictive configurations, and the close spacing of the ties, webs and connectors, create a structural weakness in the wall caused by the number of penetrations through the concrete, in addition they inhibit the natural flow of the concrete during placement increasing the difficulty of pouring the walls and causing honey comb in the concrete. The inherent weakness of the EPS makes it very difficult to vibrate the walls to increase the concrete flow and reduce the honey comb without causing the forms to bulge or blowout. In the molded-in tie and web configurations the inability of the EPS to bond to the flanges of the ties and web members allows the panels to split along the flanges under the pressure of the concrete during placement, causing the walls to bulge and blowout. In Moore, Jr. the large number of connectors that must be installed is time-consuming and the labor required is costly.

The use of EPS foam as a form material, the use of small unit sizes and the restrictive tie, web and connector configurations cr ate difficulties that must be ov rcom . When using small unit sizes there are more units to set increasing the labor required to erect a wall. There are more horizontal and vertical joints increasing the possibility of blowouts during concrete placement and a greater amount of bracing is required to straighten and stabilize the walls. Great care must be taken while placing the concrete to prevent blowouts, the concrete must be placed slowly and in short lifts. Also when EPS foam is exposed to sunlight for any period of time it deteriorates causing a powder to form on the surface of the panels, thus when using finish materials which require a strong bond to the substrate special treatment is required to remove the deterioration. Because EPS does not readily accept most finish materials an additional substrate must be installed when using finish materials that bond directly to the wall, resulting in increased costs. A large amount of labor is required to prepare the numerous horizontal and vertical joints before the application of finish materials. Another downfall of the known art systems is th lack of an easy method for securing wall reinforcing, manual tying of the wall reinforcing is time-consuming and the extra labor required is costly.

BRIEF SUMMARY OF THE INVENTION

The primary object of this invention is to provide a system for constructing Insulated concrete structures that is us r friendly, is durable nough to withstand handling during

shipping and erection without being severely damaged and will withstand the extreme forces applied by fluid concrete wh n casting a wall without bulging or failing.

Another object of this invention is to provide an improved form many times larger than other systems requiring less time to erect a structure and reducing the number of horizontal and vertical joints in a wall, reducing the amount of bracing required to stabilize the walls and requiring less preparation for interior and exterior finish materials.

Another object of this invention is to provide a means of reinforcing the foam plastic panels to resist deflection and physical damage, allows the direct application of exterior and interior finish materials thereby reducing the cost of finishing walls and also protecting the foam plastic from UV degradation during storage, shipping and installation.

Yet another object of this invention is to provide an embedded stud that extends the full height of the forms strengthening the forms, provides an additional means of fastening interior and exterior finish materials and accepts slide-in spreaders to interconnect the form panels, variable spacing of studs allows additional strength to be added for greater lift heights during concrete placement and casting of thick walls.

Still yet another object of this invention is to provide a slidable spreader for connecting form panels which provides ease of installation and allows more compact shipping of forms, varying spreader sizes allowing a large variety of poured wall thicknesses.

A further object of this invention is to provide a means for spreaders to lap the horizontal joints between vertically stacked rows of forms forcing the wall to act as one unit from bottom to top, creating greater strength and stability during construction and concrete

placement.

A further object of this invention is to provide a means for slid -in spread rs with multiple formations that compliment each other securing wall reinforcement bars in place there by reducing the amount of manual labor required to fasten and maintaining alignment of reinforcement bars during concrete placement.

A further object of this invention is to provide a slide-in spreader with multiple formations that allows wall reinforcement bars to be placed in any location required by professional engineers.

A further object of the invention is to provide a slide-in spreader with minimal obstructions in the wall cavity, allowing for the natural flow of concrete in the cavity during concrete placement, something unavailable in other systems.

Yet a further object of this invention is to provide for a slide-in spreader and embedded stud enabling the forms to be cut and utilized at any desired height.

Yet a further object of this invention is to provide for slide-in spreader and embedded stud installation at any vertical joint enabling the forms to be cut to any length, eliminating the need for additional bracing to prevent blow outs during concrete placement.

Another object of this invention is to provide a means of reinforcing the panels at their vertical midpoint utilizing horizontal stiffeners, the stiffeners having a hollow cross-section enabling them to accommodate electrical wiring.

Still yet another object of this invention is to provide forms having vertical or horizontal hinges which can be shipped flat and then rotated into position on site. Vertical hinged forms allowing the formation of unlimited angles and tee walls. Horizontal hing d

forms can be utilized as bearing ledges for brick, rock and many other applications.

Other objects and advantages of the present invention will become apparent from the following descriptions, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

The inherent problems of the prior art are overcome by the present invention, which provides a system for constructing insulated concrete structures comprising large form panels molded from a closed cell foam plastic. Each panel has a foam core between outside and inside reinforcement layers, the reinforcement layers extend substantially ov r, and are adhered to, the entire outside and inside surfaces of the foam plastic core. Embedded vertical studs extend the full height of the panel and a horizontal stiffener extends the full length of each panel at the vertical midpoint. The horizontal stiffeners having a hollow cross-section which may be utilized to accommodate electrical wiring. Each pan l has an interlocking means comprising a tongue at the top edge of each panel and a groove at the bottom edge of each panel. The reinforcement layers on each panel extending around each tongue and into each groove, reinforcing and defining the surfaces of the tongue and groove. The groove of each panel has appendages protruding into the groove, the spacing of the appendages corresponding with the locations of the embedded studs, the tongue of each panel having slots that compliment said appendages, such that when said panels are stacked the appendages in the grooves engage the slots in the tongues forcing studs from adjacent pan ls into a v rtical alignm nt. Th clos d cell foam

plastic is easily molded and has great strength and adhesive capabilities, allowing the pan ls to be cast in virtually any siz and permanently adheres to the studs and reinforcement layers creating an integral unit. The reinforcement layers add substantial strength to the panels, provides a UV resistant surface on the panels and are marked for visually locating the embedded studs and horizontal stiffeners. The reinforcement layers also provide a substrate for finish materials which substantially reduces the cost of finishing the wall, something which is unavailable in other systems. The studs embedded in the panels and bonded to the foam plastic add great strength to the forms, accommodate slide-in spreaders to interconnect the form panels and provide a continuous means for attaching finish materials. The panels are placed in an opposing relationship and connected by a plurality of spreaders at each stud location that slide into the studs and extend between the opposing panels, thereby creating a form with a cavity between the inside surfaces of the panels. The spreaders comprise opposing flanges oriented in a spaced apart parallel relationship, being connected by horizontal members, each horizontal member having multiple formations to accommodate wall reinforcement bars. The open design of the spreaders allows the concrete to flow naturally through the wall making concrete placement easier and resulting in a much stronger wall than the prior art. There are different widths of spreaders allowing the casting of a variety of different wall thicknesses.

Multiple form panels are placed end to end in horizontal rows and stacked vertically, panels are staggered from each other so that ends of opposing panels are offset and end joints between adjacent rows of stacked pan ls do not lin up vertically. There are

pluralities of spreaders at each stud location, the spreaders being "full height spreaders," half th vertical height of panels, and "half height spreaders," half the height of the full height spreaders. Spreaders are stacked vertically starting with a half height spreader with full height spreaders thereafter, so that at the top of each row of panels there is a full height spreader that slides into the studs in the row below half its height and into the studs in the row above the remaining half of its height, thereby stiffening the horizontal joint between rows of forms and forcing the walls to act as one unit from bottom to top. When the spreaders are stacked, the formations in the top and bottom horizontal members compliment the formations in adjacent spreaders allowing horizontal wall reinforcement bars to be locked in any preferred location, eliminating most manual tying of the reinforcement.

In another embodiment of the invention a hinged form is provided, comprising at least one vertical or horizontal pivotal point in at least one of the opposing form panels. Hinged panels can be shipped flat and then rotated into position on site. Forms with vertical pivotal points in both of the opposing panels can be used to form corners of any angle, allow tee walls to be formed easily and can also be used to form curved walls. Forms with a horizontal pivotal point in one of the opposing panels can be used to form bearing ledges to support brick or rock and are useful for many other applications. The bearing ledge forms utilize a specialized bearing ledge connector which allows the bearing ledge to be installed at any location in a wall.

The large unlimited form sizes, the reinforced foam plastic, the stud and spreader int rface and the ability to lap the spreaders over the horizontal joints between rows of

panels provides many benefits. The large forms require less time to place than prior art syst ms and the number of v rtical and horizontal joints are reduced. Th forms may be shipped as more compact units and assembled on site reducing the cost of shipping. The reinforcement layers strengthen the foam plastic core, protect the forms from being damaged during shipment and construction and protect them from UV deterioration. The reinforcement layers also allow finish materials to be applied directly to the forms, greatly reducing the cost of finishing the walls. Lapping the spreaders over the horizontal joints straightens, strengthens and stabilizes the walls during construction and concrete placement by forcing the walls to act as one unit from bottom to top, requiring very little bracing during construction and concrete placement.

It can be seen that the present invention provides many useful benefits that the known art systems cannot.

The drawings constitute a part of this specification and include exemplary embodiments to the invention, which may be embodied in various forms. It is to be understood that in some instances various aspects of the invention may be shown exaggerated or enlarged to facilitate an understanding of the invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1A** is a perspective view of a reinforced composite form according to the present invention.

FIG. **1B** is a top view of the form of FIG. **1A**.

FIG. **1C** is a side view of the form of FIG. **1A**.

FIG. **1D** is a cross-section view of the form of FIG. **1A**, taken along line 1D-1D as shown in FIG. **1C**.

FIG. **2A** is a perspective view of a spreader according to the present invention.

FIG. **2B** is a side view showing different sizes of the spreader of FIG. **2A**.

FIG. **3A** is a perspective view of a stud according to the present invention.

FIG. **3B** is a perspective view of an embodiment of the invention showing a stud with apertures along its length.

FIG. **4A** is a graph showing the deflection of known art panels in inches at various water column heights, with equivalent pounds per square inch pressure shown in parentheses (PSI).

FIG. **4B** is a graph showing the deflection of the panels disclosed in the present invention with a reinforcement layer on one side of the panels.

FIG. **4C** is a graph showing the deflection of the panels disclosed in the present invention with reinforcement layers on both sides of the panels.

FIG. **5A** is a perspective view of a hinged panel according to the present invention.

FIG. **5B** is a perspective view of a hinged corner form according to the present inv ntion, utilizing hinged panels of FIG. **5A** with vertical pivotal points .

FIG. **5C** is a perspective view of a hinged corner form according to the present invention oriented at an oblique angle, utilizing hinged panels of FIG. **5A** with vertical pivotal points.

FIG. **6A** is a perspective view of a bearing ledge form according to the present invention, utilizing a hinged panel of FIG. **5A** with a horizontal pivotal point.

FIG. **6B** is a top view of the bearing ledge form of FIG. **6A**.

FIG. **6C** is a side view of the bearing ledge form of FIG. **6A**.

FIG. **6D** is a cross-section view of the bearing ledge form of FIG. **6A**, taken along line 6D-6D as shown in FIG. **6C**.

FIG. **7** is a perspective view of a bearing ledge form connector according to the present invention.

FIG. **8** is a perspective view of elements of the present invention illustrating interaction with wall reinforcement bars.

FIG. **9** is a perspective view of elements of the present invention interacting to form a reinforced composite system for the construction of insulated concrete structures.

DETAILED DESCRIPTION OF THE INVENTION

Detailed descriptions of the invention are provided herein. It is to be understood, however, that the present invention may be embodied in various forms. Therefore, specific details disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for teaching one skilled in the art to employ the present invention in virtually any appropriately detailed system, structure or manner.

Turning now to the drawings, there is shown in FIGS. **1A** - **9** a reinforced composite forming system for constructing insulated concrete structures. A first embodiment of the present invention a form unit **10**, as shown in FIGS. **1a-1d** comprises panels **11** having outside surfaces **12** and inside surfaces **13**, top **20**, bottom **22** and end edges **24**. Studs **40** and a horizontal stiffener **25** are embedded in each panel. The panels **11** are placed in an opposing and parallel relationship. Spreaders **30** are located at each stud **40**, extending between and engaging the studs **40** in opposing panels **11** thereby creating a form **10** with a cavity between the panels **11**. The cavity is filled with fluid concrete to create a structure. The structural design of the concrete structures is based on the Uniform Building Code and other accepted building codes.

The panels **11** comprise a closed cell foam plastic core **14** between an outside reinforcement layer**19** and an inside reinforcement layer **21**. The reinforcement layers extend substantially over, and are adhered to, the entire outside and inside surfaces of the

foam plastic core **14** thus defining the outside surface **12** and inside surface **13** of each panel. Th outsid r inforcement layer **19**, the foam core **14** and th insid r inforcement layer **21** are continuously bonded together over their entire area thus acting together as a composite structure.

A means of interlocking the panels is provided comprising a tongue **16** that extends from and is parallel to the top edge **20** of each panel **11**, and a complementary groove **17** recessed into and parallel to the bottom edge **22** of each panel **11**. The inside reinforcement layer **21** of each panel extends around the tongue **16** and into the groove **17**, defining and reinforcing them. The embedded studs **40** extend through the groove **17** in each panel **11** and the tongue **16** has slots **18** that correspond with the studs **40** so that when the forms **10** are stacked the studs **40** engage the slots **18** in the tongue **16** of the row of forms below, aligning studs **40** of adjacent panels **11** vertically. In a second embodiment a preformed unit is used to form the tongue **16** and groove **17**. The preformed tongue **110** and groove **111** units are preferably made of plastic with appendages **115** protruding into the groove unit **111** and corresponding with the spacing of the studs **40**. The appendages **115** in the groove unit **111** of each panel engage the slots **18** in the tongue **16** of the row of forms below, aligning studs **40** of adjacent panels **11** vertically. The interface of the panel **11** ends **24** comprises a stud **40** halfway into and protruding halfway from the end **24** of a first panel **11**, and a complimentary slot **28** in the end **24** of a second panel **11**. Additionally, the panels **11** may be cut anywhere along their length and slotted **28** to accept a stud **40**. When the panels are placed end **24** to end **24**, they

interlock and spreaders **30** are installed to connect the opposing panels **11**. Thus the pr sent inv ntion discloses a m thod of utilizing studs **40** and spreaders **30** at the vertical joints between panels **11** to prevent bulging and blow outs, something the prior art does not.

The closed cell foam plastic is preferably a plural component polyurethane consisting of an isocyanate A component and a polyol B component, which when combined react to create an expansive foam which is dispensed into molds to form the panels **11**. The polyurethane foam preferably has a tensile strength of 30 - 45 P.S.I. and is classified by the Uniform Building Code as Class 1 fire-rated per ASTM-E-84-77a. The polyurethane foam has other advantageous properties such as a high insulation value per inch, great structural strength, low water absorption, a high impedance to sound transmission and excellent adhesive capabilities. The panels **11** can be molded in virtually unlimited sizes. Typical sizes will be 8 feet to 16 feet long and 2 feet 8 inches to 4 feet high, with panel **11** thicknesses from 2 inches to 6 inches depending on structural and insulation requirements. Preferred sizes for residential, commercial and industrial construction are 8 feet and 16 feet long with a height of 2 feet 8 inches and 16 feet long with a height of 4 feet.

The reinforcement layers **19** and **21** are preferably a fire resistant, flexible, fibrous material between .025 inches and .0625 inches thick and having a minimum tensile strength of 1200 P.S.I. The fibrous quality of the reinforcement layers strengthen the bond with the foam plastic, the tensile strength determines the overall deflection of the

composite panels. Typically a fiberglass material approved for use as a substrate for stucco and elastomeric coatings will be used for th outside reinforcement layer **19**, thus in addition to reinforcing the foam plastic core **14** the reinforcement layer can provide a prepared substrate for finish materials saving time and material costs. The inside reinforcement layer **21** preferably has a smooth outer surface allowing the concrete to flow easily inside the forms **10**. Both the outside and inside reinforcement layers are UV resistant and protect the foam plastic core from degrading in sunlight. The outside reinforcement layer **19** is also marked for visually locating the embedded studs.

In a preferred embodiment the boundary of the outside surface **12** of each panel **11** is tapered **23** around the full perimeter of each panel. The taper **23** starts at each panel edge approximately 1/8 inch below the panel surface **12** and extends 2 inches toward th center of the panel **11** at which point the taper **23** is flush with the panel face **12**. When installing stucco and elastomeric coatings over known art systems the joints must be pre-treated to prevent the finish from cracking over the joints between form panels, this pre-treatment usually causes a bulge in the finish coat at each joint location. The taper around the edges of the panels of the present invention allows the pre-treatment to be installed flush with the surface of the panels eliminating unsightly bulging in the finish over the joints.

In the preferred embodiment the adhesive property of the polyurethane foam is used to adhere the outside **19** and inside **21** reinforcement layers to the foam plastic core **14**, once bonded together these components act together as a composite unit. These composite form panels have amazing strength compared to known art systems. FIG. **4A**

shows typical deflections of known art panels in a testing chamber utilizing water to simulate concr te pressure, the known art panels failed at approximately 64" of water column. FIG. **4B** shows deflection of panels of the present invention having a reinforcement layer on only one side of the foam plastic core, the panel did not fail in the tests. FIG. **4C** shows deflection of panels of the present invention having reinforcement layers on both sides of the foam plastic core. The acceptable deflections shown in FIG. **4C** were achieved using reinforcement layers having a 1200 P.S.I. tensile strength, deflection can be diminished using reinforcement layers with greater tensile strength. The studs **40**, and horizontal stiffeners **25** are permanently embedded in the panels **11** during the molding process, creating a strong integral unit, as a result the embedded studs **40**, and horizontal stiffeners **25** strengthen and reinforce the foam plastic. The combination of the outside reinforcement layer **19**, inside reinforcement layer **21**, studs **40**, horizontal stiffeners **25** and foam plastic adds great strength to the forms **10**. It is shown that the panels **11** of the present invention have much greater strength than the prior art, the foam plastic material is stronger and when it adheres to the panel components the form units **10** have even greater strength during material handling, construction and concrete placement.

Having reference to FIGS. **2a-2b** and FIGS. **3a-3b** the spreaders **30** and studs **40** are preferably extruded from plastic such as Acrylonitrile Butadiene Styrene (ABS), High Impact Polystyrene (HIPS), High Density Polyethylene (HDPE) or Polypropylene (PP), and are then punched or routed to obtain the finish parts.

The studs **40** (FIG. **3a**) comprise a flange **41** for fastening finish materials and a

groove **42** for sliding spreaders **30** into, with a web member **43** extending there between to int rconnect th flange **41** and the groov **42**. Ther ar at least two studs **40** in each panel **11** that extend vertically the full height of the panels **11**, providing a means of interconnecting opposing panels **11** and providing continuous means of attaching finish materials. The spacing of the studs **40** will vary from 8 inches to 16 inches depending on the thickness of the concrete core. The web member **43** comprises a vertical member which is oriented transversely to the flange **41** and the groove **42**, in a second embodiment of the stud **40** (FIG. 3b) the web **43** has a plurality of apertures **44** along its length to enhance the bond with the panels **11**.

The spreaders **30** as shown in FIG. **2a**, comprise opposing flanges **31** connected by horizontal members **32**, the flanges **31** slide into the grooves **42** of the studs **40**. Each horizontal member **32** has multiple formations **33** to accommodate wall reinforcement bars. Preferably there are "full height spreaders" and "half height spreaders" as disclosed in a further embodiment which will be discussed later. The number of horizontal members **32** will vary depending on the thickness of the concrete core, typically the full height spreaders will have three horizontal members **32** and the half height spreaders will have two horizontal members **32**. The topmost horizontal member is located substantially at the top of the flanges **31** and the bottommost horizontal member is located substantially at th bottom of the flanges **31**. The formations **33** in the horizontal members **32** of both spreader configurations will occur in the top of the topmost member and in the bottom of the bottommost memb r. When th spreaders are stacked the bottom horizontal member of

the spreader above will rest on the top member of the spreader below, the complimentary formations **33** forming a full circl allowing wall r inforcem nt bars to b r strained within the formations. The intermediate horizontal members will preferably have formations **33** on both sides of the member allowing the spreaders **30** to be reversible. Intermediate wall reinforcement bars if required will rest in the formations **33** of the intermediate horizontal members. The open design of the spreaders **30** allows the concrete to flow naturally through the wall, making concrete placement easier and resulting in a much stronger wall than the prior art. The spreaders **30** vary in width (FIG. **2b**) to facilitate the casting of different concrete wall thicknesses, the walls are typically cast with concrete cores from 4 inches to 12 inches thick, the spreader **30** size increases in 1 inch increments to facilitate these different wall thicknesses. The slide-in spreader **30** configuration allows the panels to be shipped in compact units which reduces shipping costs. The slide-in spreaders **30** are quickly and easily installed saving time and money erecting the structures.

The horizontal stiffeners **25** preferably are made of similar plastic to the studs **40** and spreaders **30** or Poly Vinyl Chloride (PVC), and have a hollow cross-section. The horizontal stiffeners **25** are located at the midpoint of the panels **11** vertically and 1-1/4 inches from the outside face **12** and extend the length of the panels **11** horizontally. The stiffeners **25** can be utilized as a chase way for electrical wiring.

Another embodiment of the present invention, FIG. **5A** - **5C** shows hinged form panels **90**, comprising panels **11**, having at least one vertical or horizontal pivotal point **100** extending substantially across the panel. The pivotal point **100** creates discontinuous panel

sections, being connected together by a flexible pivotal member **102**, the discontinuous pan l s ctions are rotationally ind p ndent from each other. Preferably the pivotal member **102** is a flexible mesh that is adhered within the panels when they are molded, the panels being molded with discontinuity at each pivotal member **102**. The hinged panels **90** can be bent to form corners, angles or tee walls, multiple pivotal points **100** can be installed in the panels **11** to form curved walls. The hinged panels **90** can be shipped flat to save space and then rotated into position on site. FIGS. **5B** and **5C** show hinged form panels **90** placed in an opposing spaced-apart relationship having a vertical pivotal section **100** in each of the opposing panels being used as corner forms **50**. The outer panel defines the outside **51** of a corner **50**, the inner panel defines the inside **52** of a corner **50**. FIG. **5C** shows a corner **50** formed at an oblique angle. Hinged forms **90** allow building corners to be erected quickly with little bracing.

Another embodiment of the present invention, FIGS. **6a-6d** discloses a bearing ledge form **60** for the support of brick, rock and other veneers comprising a hinged form panel **90** and a conventional form panel **11** placed in an opposing and spaced-apart relationship. The hinged form panel **90** having a horizontal pivotal point **100** and two discontinuous panel sections **11A** and **11B**. The first discontinuous panel section **11A** defining a plane **63**, the second discontinuous panel section **11B** having a first plane **64** and a second plane **65** at an angle to one another. The second discontinuous panel section **11B** is rotated such that the first plane **64** of said panel section extends at an angle to the plane **63** of the first discontinuous panel section **11A** and the second plane **65** of the

second discontinuous panel section **11B** is parallel to offset from the plane **63** of the first discontinuous panel s ction **11A** forming a haunch **66**. Th hinged form panel **90** has embedded studs **40** in the first **11A** and second **11B** discontinuous panel sections that extend to the pivotal point **100**, the studs are spaced longitudinally and parallel from each other. Specialized bearing ledge connectors **70** (FIG. **7**) slidably engage the studs **40** located in the second discontinuous panel section **11B**. The bearing ledge connectors **70** comprise a flange **71** for engaging the studs and a groove **72** for receiving spreaders, the flange **71** and groove **72** connect at a point, the flange **71** extending outwardly at an angl from the groove **72**. The outermost extent of the flange **71** and groove **72** are connected by a web member **73**, the web member **73** has formations **74** for wall reinforcement bars. The conventional form panel **11** has embedded studs **40** that extend substantially the full height of the form panels **11**, the studs are spaced longitudinally and parallel from each other. A plurality of spreaders **30** at each stud **40** location extend between opposing panels and engage the studs **40** and bearing ledge connectors **70** in opposing panels creating a form with a cavity between the inside surfaces of the panels.

Multiple form panels **11** are stacked together to form walls (FIG. **9**), the panels **11** are placed in an opposing parallel spaced apart relationship with spreaders **30** that extend between the panels **11** and slide into the studs **40** thereby forming a cavity between the inside surface **13** of the panels **11**, the cavity is then filled with fluid concrete. The panels **11** are placed end to end in rows and stacked vertically, the opposing panels **11** may be offset from ach other so that th pan l nds **24** do not line up from one side of the wall to

the other **27**, the rows of panels **11** ar staggered back and forth so the end joints **29** of adjacent pan ls do not line up vertically. As the panels **11** ar stacked, spr ad rs **30** are installed, which slide into and engage the grooves **42** of the studs **40** embedded in the opposing panels **11**. The spreaders **30** are "full height spreaders" **34,** which are half the height of the panels and "half height spreaders" **35,** which are half the height of the full height spreaders **34**. A half height spreader **35** is installed at the bottom of the wall with full height spreaders **34** thereafter, so at the top of each row of panels the spreaders **30** engage the studs **40** in the row of panels **11** below half their height and engage the studs **40** in the row of panels **11** above the remaining half of their height. Thus the present invention discloses a novel spreader **30** which overlaps the horizontal joints between rows of forms **10**, connecting the rows and forcing the wall to act as one unit from bottom to top and also preventing the joints from shifting and bulging or causing blowouts, therefore very little bracing is required to straighten the walls and stabilize them during concrete placement. The formations **33** in the top and bottom horizontal members **32** of the spreaders **30** compliment the formations **33** in the spreaders **30** above and below allowing horizontal wall reinforcement bars to be locked in place. There are multiple formations **33** in each horizontal member **32** so the reinforcement bars can be installed at any location that might be required by professional engineers. FIG. **8** shows wall reinforcement bars **81** locked in the complimentary formations **33** of the spreaders **30**. The ability of the spreaders **30** to lock reinforcement bars **81** in place eliminates most manual tying of the wall reinforcement. The full height studs **40** embedd d in each form pan l **11** allow them to

be cut to any height and still provide a structurally sound unit, also door, window and other openings can b cut at any location without compromising the integrity of the wall.

There are many advantages over the prior art disclosed in the present invention:

The closed cell foam plastic is easily molded and has superior strength and adhesion, allowing the form panels to be cast in unlimited large sizes, and allows the reinforcement layers to be adhered to the panels and the studs embedded and bonded within the panels creating stronger form units.

The reinforcement layers add substantial strength to the panels during material handling, construction and concrete placement, provides a substrate for finish materials, provides a UV resistant surface on the panels and is marked for visually locating embedded studs and horizontal stiffeners.

Full height studs provide an additional means for attaching finish materials and engaging spreaders and add substantial strength to the forms.

The open configuration of the slide-in spreaders allows the concrete to flow naturally through the wall during placement, resulting in easier placement of the concrete and a much stronger wall.

Slide-in spreaders allow compact shipment of the forms and provide a means of quickly and easily erected the forms at the job site.

Formations in the spreader allow wall reinforcement bars to be locked in any preferred location.

The ability of th spreaders to overlap the horizontal joints between rows of

panels interconnects the rows strengthening the wall and forcing it to act as one unit from bottom to top.

Embedded horizontal stiffeners strengthen the panels and provide a means of easily installing electrical wiring.

Hinged forms may be shipped flat saving shipping cost and allow corners of unlimited angles and tee walls to be formed quickly and easily with little bracing.

Bearing ledge forms provide support for brick, rock and other veneers and are useful for many other applications.

The stronger, larger form sizes and the configuration of the spreaders allow structures to be erected quickly with little bracing and allow the concrete to be placed easily with no danger of bulging or blowouts.

While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may b included within the spirit and scope of the invention as defined by the appended claims.